



Project Summary Report 0-4204-S

URL: <http://tti.tamu.edu/documents/0-4204-S.pdf>

Project 0-4204: Synthesis Study on Designing an Automated Pavement Distress Equipment Certification Facility

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Development of a Prototype Crack Simulator

The primary objective of this project was to develop a method to verify the calibration of and evaluate the automated pavement distress data collection equipment, specifically for the new Texas Department of Transportation (TxDOT) automated system. The TxDOT automated pavement distress measurement equipment will be used to provide data for the TxDOT Pavement Management Information System (PMIS).

Currently, the method used to inspect pavements in Texas involves having crews (contractor, TxDOT, and Texas Transportation Institute [TTI] personnel) attend training classes to become certified inspectors for the calendar year. During the inspector certification training, changes to the manual, including clarifications and interpretations, and

inspections of selected sections are used in order to reduce the rater-to-rater variability.

For the actual production inspections, the contractor teams drive at approximately 15 miles per hour (mph) along the shoulder or in the lane and estimate the quantity of each distress type for a given length. For all asphalt surfaces and continuously reinforced concrete pavement (CRCP), the length used to estimate distress is 40 feet, which in the field is the distance from the start of one lane stripe to the start of the next lane stripe. For jointed reinforced concrete pavement (JRCP), most of the distresses are estimated for each slab or joint. Except for the under-construction or otherwise identified miles, nearly 100 percent of the system is inspected manually. For roads that have undivided roadbeds, only one lane

(the lane in the worst condition) is inspected. For divided roads, one lane in each direction is inspected. TxDOT hires contractors to perform this service and has personnel from TxDOT and TTI check the results by performing an audit survey of a small percentage of the pavements.

In spite of the best efforts of TxDOT and all parties involved, there are significant problems with the current inspection method:

- One problem is certainly the cost. The annual cost of these inspections is approximately \$2,000,000. When the current contract expires and is renegotiated, costs typically increase.
- Vehicles driving very slowly along the shoulder or within the lane are a potential safety hazard for both the inspectors and the traveling public.



- There is considerable variability in the inspections. Normally, inspections during class would be expected to be very consistent and have a smaller standard deviation than there would be during production inspection because:

- all parties know they are being observed;
- there would be no “burn out” since only a few pavements are inspected during class;
- there is no incentive, time limit, or rush to finish the inspection;
- definitions of distresses to be used are fresh in the minds of the inspectors; and
- there are three or four inspectors in each vehicle, so no distresses should be missed.

- Inspectors in different regions may be rating differently. Since there is no overlap of inspections on the same pavements, this hypothesis is never tested.

What We Did...

After reviewing the current TxDOT data collection procedures and data needed for distress data collection, researchers identified several methods of providing safe, reliable, repeatable, and

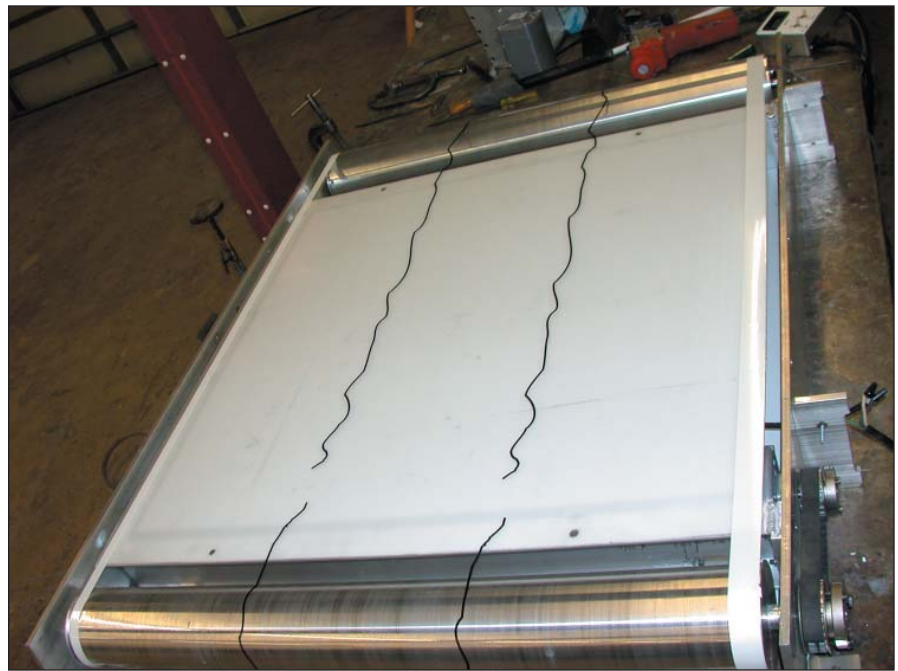


Figure 1. Prototype Crack Simulator.



Figure 2. Testing of Prototype Crack Simulator.

quantifiable procedures for verification of calibration and evaluation. The various methods for verification were investigated and the “best” technique, a crack simulator machine that can illustrate different crack types and widths, was selected. A prototype of the proposed

crack simulator was designed, constructed, and tested.

The prototype unit was designed so that readily available, existing materials could be used for crack simulation. The design was based on standard mylar film that could be easily printed on



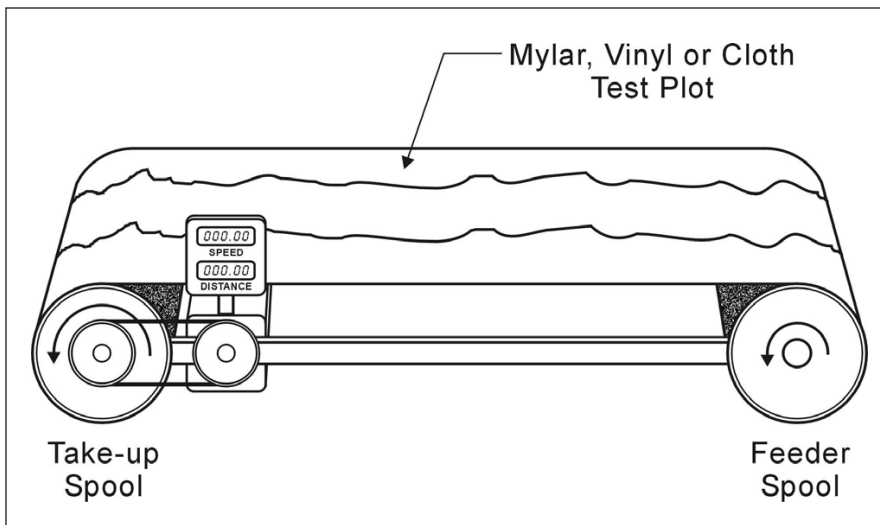


Figure 3. Schematic of Proposed Large-Scale Crack Simulator.

production-type roll printers. With this design, a 3-foot-wide footprint was the maximum width that could be used without expensive, specialized equipment. Since the TxDOT automated distress measurement system uses a digital line-scan camera, the length of the mylar film was not a critical dimension in the initial prototype. The optimal speed of the simulator was to be designed to be 60 mph. Specifications were developed for two production-type units.

What We Found...

Researchers investigated many methods, including:

- pavement test sections,
- video projection,
- mylar clamped to road surface, and
- mylar or canvas on a rolling platform.

The advantages and disadvantages of these methods were identified and discussed, and the rolling platform crack simulator was chosen due to its inherent advantages of ease of use, safety, reliability, repeatability, and the ability to accurately quantify distresses, especially with respect to evaluating the ability to measure cracks of different widths. A prototype was constructed so that researchers could identify the improvements that needed to be made to the prototype. Continuous loops of mylar film with different crack widths and types of distress were produced and tested using TxDOT equipment. [Figures 1 and 2](#) illustrate the prototype device.

Based on the results of the testing and discussions with TxDOT personnel, two slightly different types of production

crack simulators were proposed. The first design is a unit with a 5-foot-wide simulated road bed (5 feet being close to a half-lane width). The second design is a scaled-down version of design 1. [Figure 3](#) illustrates the proposed production device.

Design 2 would have a smaller camera viewing bed (3 feet wide by 1 foot long), and was specifically designed to be taken to the field to verify calibration on production units.

The researchers investigated methods of producing the prints of the distress images and found several companies that are able to produce prints of the quality required on either nylon or vinyl. This is the most cost-effective option.

The Researchers Recommend...

Researchers recommend that TxDOT build and implement both of the production crack simulator designs described in Report 4204-1. The sooner the manual methods currently in use can be replaced with calibrated, certified, automated equipment, the more repeatable measurements of the actual condition of pavements in Texas will be available to administration, maintenance, pavement design, pavement management, and researchers.



For More Details...

Related Report: Report 4204-1, *Development of Certification Equipment for TxDOT Automated Pavement Distress Equipment*

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TxDOT Implementation Status—January 2005

The equipment developed by this project is merely a prototype. Recommendations for improving this device will be implemented by the Construction Division of TxDOT.

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